

**Global Change Scenarios: Their Development and Use
Synthesis and Assessment Product 2.1b, US CCSP**

Responses to comments from Michael MacCracken, Climate Institute, August 14, 2006

November 1, 2006

II. General Comments

First General Comment: This is a very impressive and comprehensive overview of the issues concerning scenarios. Compliments to the authors.

No response required.

Second General Comment: The essential absence from this report of any discussion of advances or uses of scenarios as a result of efforts sponsored by the Climate Change Science Program is a rather telling indictment of the program's imbalance these past several years. Finally, after 6 years, the CCSP is at least getting some very nice input about what it should have been doing for the last 6 years, and should be doing much more extensively in the future.

No response required.

III. General Comments

Page 4, lines 37-39: The US National Assessment was also sued by a group that asserted that because the two climate change scenarios it used were different, one had to be wrong, and this violated the Federal Data Quality Act; of course, most experts would agree that all scenarios are wrong—they are only plausible futures. In that the FDQA really is intended to apply to data, meaning something that was observed or happened in the past, the lawsuit was not successful and was withdrawn, it is important to make clear that having a broad range of scenarios is the most appropriate thing to do.

Response: We agree, and the report stresses that scenarios are not confident projections of any particular future chain of events, and that one of their primary contributions is to characterize major uncertainties to facilitate exploration of their implications.

Page 5, lines 6-8: In reality, the US National Assessment was also planned to be an ongoing activity and not a single event; indeed, the Global Change Research Act calling for assessments envisions the assessment process completing major reports every four years, so it would have to be an ongoing process. That it was a single event was a decision of the incoming CCSP Administration, and the misleading statement here should be corrected. I would also note that I did not see mention that it was a single even in the supporting sections, so I am not sure why this point is made here.

Response: The revised report notes the importance of building and sustaining capacity repeatedly in the main text, but this point is not leveled as a criticism that applies uniquely to the National Assessment.

Page 11, line 9: I would suggest that it is important to note, however, that there needs to be time-resolution of something like a decade or so, not just the change over a century.

Response: We agree. The prior draft's ambiguity about the recommended time resolution has been corrected.

Page 19, line 9: Not meaning to be provincial, but one possible reference for this section might be MacCracken, M. C., 2002: Do the uncertainty ranges in the IPCC and US National Assessments adequately account for possibly overlooked climatic influences? *Climatic Change* 52, 13-23 where an attempt was made to make some distinctions.

Response: The article provides a careful discussion of the distinction between predictions and projections, but does not consider the relationship of scenarios to either of these. Consequently, we do not think it sufficiently relevant to cite in this passage.

Page 34, lines 7-9: Just to note here (and the comment may be more appropriate for some other location), but what really matters (or should matter in the calculations) are not just the total SO₂ emissions, but also the height distribution of the emissions, and a time history of this is needed as well. So, again, it is fine to have emissions scenarios, but for representing climate effects, more information is needed.

Response: We agree, and the report notes climate modelers' interest in this level of detail in emissions scenarios.

Page 55, line 13: Actually, several products of the US National Assessment were completed in 1999, and a couple took until 2003.

Response: This has been corrected.

Page 63, lines 28-38: Not mentioned in the write-up on the USNA is that there was also an attempt made under the auspices of Oak Ridge to do a technology assessment—what might evolve technologically in the country and how might that affect the situation. Efforts on this were also quite limited and not very successful, but it is an area that needs attention for the future.

Response: We did not judge this effort to be closely enough related to the use of scenarios in the Assessment to merit inclusion in the limited space available.

Page 124, line 6: It seems to me that an important conclusion to make somewhere, perhaps in this subsection, is that one does not need to wait until one has certain results before constructing scenarios and making productive use of them. This report earlier made this point, but it needs to be explicitly made in the conclusions. Instead, scenarios are a way of dealing with uncertainties—not something one does after the science is certain.

Response: The point has been added explicitly to the discussion of conclusions concerned with scenarios and decision-making.

Page 131, line 25: The spelling should be “MacCracken”. Thank you in advance for proper capitalization.

Response: This has been corrected.

Page 133, lines 28-31: I was surprised to see that apparently only one chapter in the NAST Foundation report was cited. Should it not be cited in its entirety as well, and should not some of the other chapters be cited?

Response: The revised report cites the complete report under author “National Assessment Synthesis Team”, plus the two chapters that address climate scenarios and socio-economic scenarios.

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**Responses to comments by Eric Holdsworth and William Fang,
Edison Electric Institute.
November 1, 2006**

NOTE: These reviewers submitted a single integrated set of comments on Parts A and B, including six long “general comments,” each including multiple points, plus specific comments keyed pages of the reports. Because of the structure of their comments – with many separate points contained within the longer comments, and many comments pertaining only to Part A – we have had to excerpt and, in many cases, paraphrase parts of their comments in order to separate the specific points that applied to part B.

“First General Comment”: Two points within this comment pertain to Part B:

- 1) They request clarification of the role of the FACA committee, and object to the suggestion that the FACA committee has authority to approve the products.

Response: The CPDAC (the FACA committee) is providing substantive criticism and review of the report, and assessing the authors’ responses to expert-review and public comments. Because the criticisms received from the committee have been cogent, constructive, and helpful, we have been happy to address their comments and the question of whether or not the committee has formal authority to approve the product has not come up.

- 2) They request clarification of how Parts A and B were coordinated.

Response: The work of the two groups has been coordinated by periodic consultations among the chairs and DOE liaisons, and through one person who served as a member of both author teams.

“Fifth General Comment”: Three points within this comment pertain to Part B, all of which are objections to the report’s presentation of arguments for and against explicit treatment of probabilities in scenarios, and the conclusion cautiously advocating more attempts to present such explicit judgments.

- 1) (pg 22) They state that the report does not address the practical objections raised to quantification of probabilities: 1) the difficulty of integrating multiple sources of uncertainty and the judgments of multiple experts about them; 2) the non-intuitive nature of using probability distributions to communicate with non-expert users.

Response: The report addresses these objections, in Section 4.6.5 and elsewhere. In sum, the responses are

- 1) This is indeed difficult, but there is no clear alternative, it is done in many other decision domains, and there are numerous elicitation devices to facilitate it. See,

for example, the forthcoming SAP on Uncertainty.

2) The risks of misunderstanding are at least as great from presenting scenarios with no information about likelihood or uncertainty, e.g., users taking a middle scenario as the way it will be, or supplying their own less informed probability estimates as many authors have done with the SRES scenarios. Moreover, as we discuss in Section 4.4, there are many visual and graphical devices, and means of expressing likelihood judgments with intermediate specificity, that can help expand users' understanding of probabilistic results, as discussed and illustrated in Section 4.4.

2) (pg 24) They reject the recommendation for scenario developers to be more explicit about their likelihood judgments, on the basis that assigning probabilities and judging the magnitudes of various risks are the responsibility of democratically elected policy-makers: "Making decisions by leaning on the crutch of probability judgments formed by others may make it easier for decision-makers, but it undermines their responsibility".

Response: We strongly disagree. To accept this criticism would be to reject the legitimacy of any expert input into characterizing risks to inform democratic policy-making. The report's recommendation that scenario developers should be more explicit about probability judgments in no way obtrudes on the authority of democratic policy-makers, since it leaves to them, appropriately, all responsibility for making decisions. Moreover, the report's call for greatly increased transparency in scenarios and their underlying reasoning, including the basis for the recommended probability judgments, is precisely intended to increase the ability of policy-makers to substitute their own judgments of risks for those of scenario developers, if they so choose.

3) They assert that calling for more explicit representation of uncertainty contradicts the report's previous use of the terms "plausible" and "potential" in defining the status of the conditions represented in scenarios.

Response: We find no contradiction between these. Stating that something represents "plausible" or "potential" future conditions in no way excludes the possibility of attempting to use relevant information and expert judgment to provide sharper and more explicit representation of its likelihood.

"Sixth General Comment": This comment contains three specific criticisms of Part B's conclusions and recommendations, the latter two of which focus specifically on the recommendation for establishment of a program to promote development of more useful scenarios and scenario-related methods.

1) They object that the conclusions and recommendations are not responsive to the statement of tasks in the prospectus because they lack recommendations for improving the scenario development process. In particular, they state that the report appears to contain only one recommendation.

Response: Although the report does not specifically separate “recommendations” from “conclusions”, by our count at least two dozen of the conclusions clearly indicate directions for improving scenarios. The recommendations have been sharpened and clarified substantially in the most recent revisions.

2) They object that the report’s recommendation that CCSP establish a program to promote development of more useful scenarios and improved scenario-related methods does not say specifically what changes should be made in scenarios to make them more useful.

Response: The report does make several specific recommendations for how to make scenarios more useful for particular types of users, for how to treat uncertainty in scenarios, for how to handle coordination of multiple models used in scenario development, and for how to structure stakeholder involvement in scenario development. Beyond these, however, the recommendation to establish the new program is crucial, because one of the report’s broadest conclusions is that there has not been enough resources or sustained attention devoted to scenario methods, or enough consideration of the specific scenario-related information needs of particular types of decision-makers.

3) (pg 28) They a) “question” whether supporting the proposed scenario development activity is a proper role for CCSP in meeting the requirements of the 1990 Global Change Research Act; b) “question” whether scenarios should command the level of resources implied by the recommendation, relative to the total investment of resources in addressing the climate issue; c) “question” whether this is an appropriate job for research and assessment organizations; and d) assert that the recommendation violates the mandate of SAP 2.1b as defined in the prospectus.

Responses:

a) The call for periodic assessments in the GCRA is utterly clear. While the Act is not specific about what precise activities comprise an “assessment,” it is clear that developing, applying, evaluating, and adapting/updating scenarios are a necessary component of many assessments, so undertaking these activities is entirely consistent with the Act.

b) Relative to the total investment in global change research, assessment, and response, the resources being discussed here, for scenario methods or for all assessment activities, are a very small fraction that can yield high value. An indication of how cheap assessment and scenario-related activities are is provided by the scale of funding of the present 21 Synthesis and Assessment Products under the CCSP, which the former director of CCSP has estimated are costing less than \$10 million total over three years, compared with roughly \$2 billion per year total US global change and climate change research funding. A few tenths of a percent of the total research budget does not seem like a lot for activities that may be crucial to synthesizing and drawing useful decision support out of the research.

c) and d) No support is provided for these claims – nor indeed for any of the four – and we frankly find these last two insupportable. Producing more useful scenarios and advancing methods to produce and use them would appear to be essential to improving the effectiveness of assessments. The mandate of SAP 2.1b gives no indication of any restriction that could conceivably be violated by this recommendation.

Specific Comments: (keyed to page/line on the public comment draft of Part B)

D. **Part B, p. 48, lines 16-17** The sentence beginning on line 16 is an overstatement in support of the SRES scenarios, particularly in light of the discussion of criticisms referred to on p. 49.

Response: While there are some valid criticisms to be leveled against SRES, as we discuss in the passage referred to and elsewhere, these in no way invalidate the overall favorable assessment of the advances achieved by SRES.

E. **Part B, p. 50, lines 19 and 21-22** We recommend that the word “critics” on line 19 be changed to “statistician and economist.” In addition, we urge that the sentence beginning on line 21 be changed to read as follows: “Their contentions were widely circulated.” Calling Castles and Henderson “critics” and referring to their comments and those of the publication The Economist and others “Climate-Change Skeptics” is pejorative and biased, particularly when one sees that some of the Part B authors were “participants” in the IPCC SRES “process” (see p. 15).

Response:

Since Castles and Henderson advanced forcefully argued criticisms of the SRES scenarios that were widely circulated by themselves and others, it is neither inaccurate nor pejorative to call them “critics.”

It is difficult to find any merit in the suggestion of bias in favor of the SRES when 1) the Report provides extensive, thoroughly argued criticisms of SRES as well as recognition of its achievements – including serious criticisms that have not been previously publicized, and; 2) Only one of the eight Part B authors was a SRES participant, while several others have been highly critical of SRES.

The report does not characterize Castles and Henderson as “climate-change skeptics,” but rather states that “their criticism was widely circulated and repeated by prominent climate-change skeptics”. It is neither inaccurate nor pejorative to call Patrick Michaels a “climate-change skeptic.” This is also an accurate characterization of the writing of The Economist on this issue, since they gave prominent and favorable coverage to the Castles/Henderson critique, yet did not report the resolution of the subsequent debate that their claims of exaggerated emissions growth were, if not outright wrong, at best unimportant.

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Responses to comments from discussion in CPDAC meeting, August 18, 2006

(Note: Comments are excerpted from meeting minutes, as posted.)

November 1, 2006

Busalacchi said that he did not understand where the three U.S. models discussed in Part a fit in with the Hadley Centre models used in Part b. There is a British program that uses a variety of models. Most models are using the SRES scenarios.

Response: Part B reviewed historical experience with scenarios, which has used multiple climate and energy models. Part A has produced new scenarios, using three current-generation energy-economic models.

Hawkins pointed out that, in the Executive Summary, on page 11, it says that “scenarios should be global in scope and century-scale in time.” That may be misinterpreted to apply to all models and needs qualification. Also, in regard to the comments calling for a more probabilistic approach, nations are often not able to respond to a threat unilaterally; rather, they assess strategic alliances with scenario analysis, which is done for these high-risk decisions without high quantification.

Response:

1) The text has been edited to clarify the recommendation that scenarios extend a century or more into the future, but also include nearer-term descriptions for those analyses that require them.

2) While many scenario exercises in the security field seek to probe the implications of alternative strategic choices by specific other actors, this situation is relatively uncommon in climate-change uses of scenarios. One major exception is use of scenarios to formulate national mitigation strategies, in the context of mitigation choices being made by other major nations. Although there is no publicly available instance of scenarios yet being used in this way, the report does discuss their potential value and some of the requirements of doing them.

Pizer said that the report is an incredible effort. The extent to which scenarios are used for input into another analytical process involves visions of the future. An end user cares about what happens 10 years from now and how the available options will be altered.

Response: The report stresses the importance of scenarios being both:

1) periodically updated as knowledge and capabilities change and new decision problems must be addressed, and

2) subjected to systematic, retrospective evaluations that have been lacking thus far.

Gutowski said that there is a disconnect among scenarios and modelers and users. There could be more substantive integration among these groups.

Response: the report stresses the importance of effective communication among the diverse areas of knowledge participation in scenario development, and between scenario producer and users.

Edmonds asked what that “permanent capacity” suggested by the SAP 2.1.b writing team might be. Might it be integrated assessment? That could develop decision-making tools. One could have a steady scenario development. He would see the tools as useful, but was not sure that constantly changing scenarios would be helpful.

Response: The section of the conclusions recommending establishment of a program to support scenario methods has been extensively revised based on the discussion at the CPDAC meeting and further discussions among the author team. The revised text sharpens substantially what is recommended, and pays more attention to the pitfalls to be avoided in establishing such a new program.

Winkler had some terminology issues and asked if they could be clarified in the report (e.g., between scenarios and projections). This will be an issue in SAP 3.1 and SAP 3.2, also. Are the model results a scenario or projections? Another issue is climate change versus emissions and global climate change scenarios.

Response: The report discusses the not always sharp distinctions between projections and scenarios in Section 1.1. In addition, the recent edits increased the consistency of usage throughout the report.

Flannery had hoped that this report would demystify scenarios. However, it often descends into heavy terminology. The Subcommittee might want to divide the use of scenarios into those considered by decision analysts and those considered by insiders. Decision makers have a reference case in their heads. Scenario writers should make a reference case of where things are going and make that explicit. There is a real merit in discussing the use of reference cases. However, using the scenario to organize the assessment becomes incestuous. Also, some large assessments are done on the basis of bad assumptions. Finally, the recommendation on capacity needs to be explained much more clearly. There are other tools (e.g., integrated assessment tools) that can be used. Scenarios are context-specific.

Response: Because current usage is often unclear and occasionally contradictory, the report spends some time attempting to clarify and demystify scenarios. Unfortunately, this has required drawing some rather academic sounding distinctions. The report does explicitly distinguish between scenarios used for decision-making more or less directly, and scenarios that serve as inputs to other analyses, model runs, or assessments. Sections 4.1 and 4.2, and the recommendations in 5.1, and 5.2, attempt to draw out the practical implications of this distinction. We do not agree that it is usually appropriate for scenario exercises to rely upon one reference case that is judged highly probable. In fact,

the report argues that scenario-based analysis is most useful when there is no basis for such confidence regarding important future trends. It is because scenarios can so readily be based on erroneous or biased assumptions that the report argues so forcefully for increased transparency regarding the underlying reasoning and assumptions that produced scenarios, rather than merely conveying the contents of the scenarios themselves. Finally, as noted in response to Edmonds' comment above, the recommendation for establishment of a new program to build scenario capacity has been substantially sharpened and clarified.

Pizer noted that nothing is exempt from politics. This report needs to communicate. Standardized emission scenarios are needed. That is a communication issue. One needs to think about the germane economic issues. Higher-resolution data may be needed in the results. This is not a trivial problem.

Response: We agree with these points, and the report addresses them.

Zhang said that one might want to refer to conditional probability in regard to scenarios.

Response: We agree, and the report addresses this point, in particular as regards making climate-change scenarios conditional on specified emissions scenarios.

Keith said that there are times when people need a set of references. One can look at how people thought 25 years ago and see how little they knew. People are probably not that much better at viewing the future now.

Response: The report discusses the risks of over-confidence in some detail, and does not recommend that scenario exercises adopt a single highest-priority reference case.

Miller asked how one prioritizes among uncertain scenarios.

Response: The report argues that this should be achieved through consultation and negotiation between those producing scenarios and those using them – or, in those cases when the set of all potential users is too large and diverse to involve directly, between producers and an appropriately diverse and representative group of potential users.

Yohe stated that one view is that everything is so inadequate that one cannot do anything. One of the clients that is not addressed is the research community itself. It is there that an infrastructure would pay off. The emphasis on the decision maker focuses on someone who needs something else. One learns from the improvements of scenarios. ... The inability to craft scenarios cannot be allowed to cripple decision making.

Response: One uses scenarios when decisions are being made, or must be, and uncertainty is too deep for conventional decision-analytic methods to be of much use. That is, an inability for decisions to wait upon more complete and precisely

specified information is one of the indicators for the potential value of scenarios. Although the report has not addressed the question of what climate-related decisions need to be made immediately, the report's recommendation for development of scenario methods is not intended to provide justification for delay when the need for near-term decisions or actions is evident. Rather, the report argues for a strongly adaptive approach to developing scenario-related capabilities: undertaking near-term activities that serve clear needs or promise potentially valuable new approaches, and progressively evaluating these and adapting the endeavor to allow more useful subsequent scenario-related activities. The revised report has added a more explicit statement that the need to improve scenario methods does not provide general justification for delaying decisions to the final concluding point in Section 5.1.

Reilly said that the report raises good issues: If one creates capacity to create scenarios, does one produce separation between institutions? Do generic scenarios separate one from the users?

Keith shared Reilly's concern. A centralized office that serves everyone and therefore no one is not wanted. What is wanted is a group to focus on history, process, and pitfalls.

Reply (to both Reilly and Keith): The revisions have stressed that the report is not recommending establishment of a "Scenarios Central" office that would (impossibly) attempt to provide all scenarios for all purposes. In fact, supporting methods development, convening ongoing evaluations, and building and sustaining relationships among research, analytic, and user communities are among the primary roles of the scenario program that the report recommends.

Burkett noted that there is a tension between efficiency and specific needs of users. The National Park Service is using the National Assessment for long-range plans for several national parks. The Department of Transportation needs to know how climate change will affect a highway in California.

Reply: We agree, and the report stresses the need for scenarios that meet users' needs for particular variables, scale, and time horizons.

Flannery suggested that what is being asked for is a capacity for agencies to ask for scenarios to help in long-range planning, not an ability to construct scenarios.

Reply: We agree, and this observation is consistent with the recommendation in the revised report. The proposed program would seek to advance methods and the ability to develop and use scenarios, but would not develop scenarios itself.